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Pasadena, California

Atmospheric Infrared Sounder

Characterization and Validation of Cloud-Cleared Radiances

E.F. Fishbein

Outline

- ***ECMF – AIRS inter-comparisons***
  - **Dependence on cloud discriminants**
  - **SST outlier rates (2K threshold)**
- ***Radiance Covariance***
  - **Clear – versus cloud-cleared**
- **Inter-comparison of versions 4.0 and 3.5**

Name	Description	Location	Time of Day	Default Condition
d2392r1	Difference of SST from LW and SW channels, SST1231r5-SST2392r1	Ocean	Day/Night	**> -2K**
d23	LW Thin cirrus and silicate dust predictor	Ocean	Day/Night	**abs < 0.25K**

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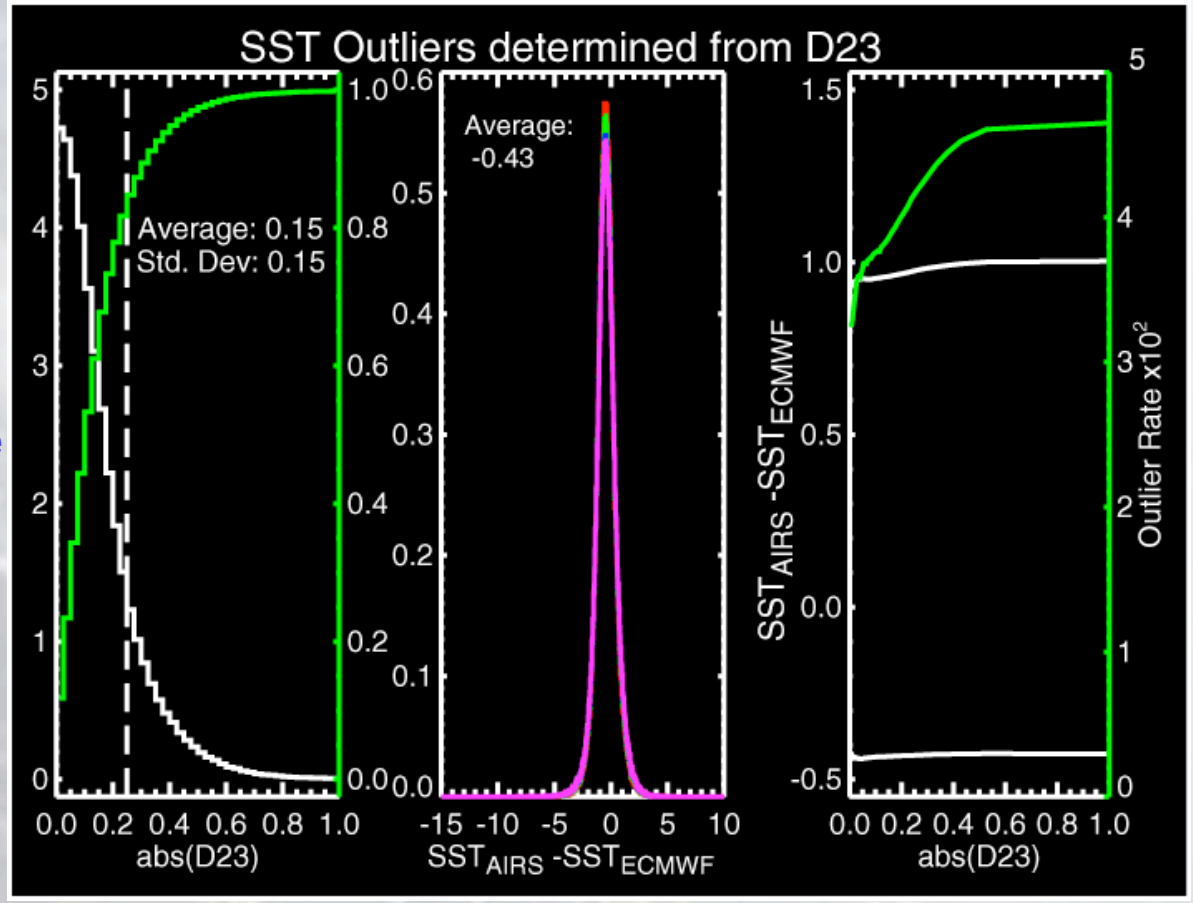
Version 3.5 SST Inter-comparisons Outlier Rate

LW Thin Cirrus Test
1231 / 943 cm^{-1}

- **Discriminant smaller than clear threshold (density of discriminant)**
- **Density of SST differences are independent of discriminant**
- **Precision (bias) and accuracy of SST independent of discriminant**

Cloud-clearing is working to reliability of discriminant and/or Correlative SST



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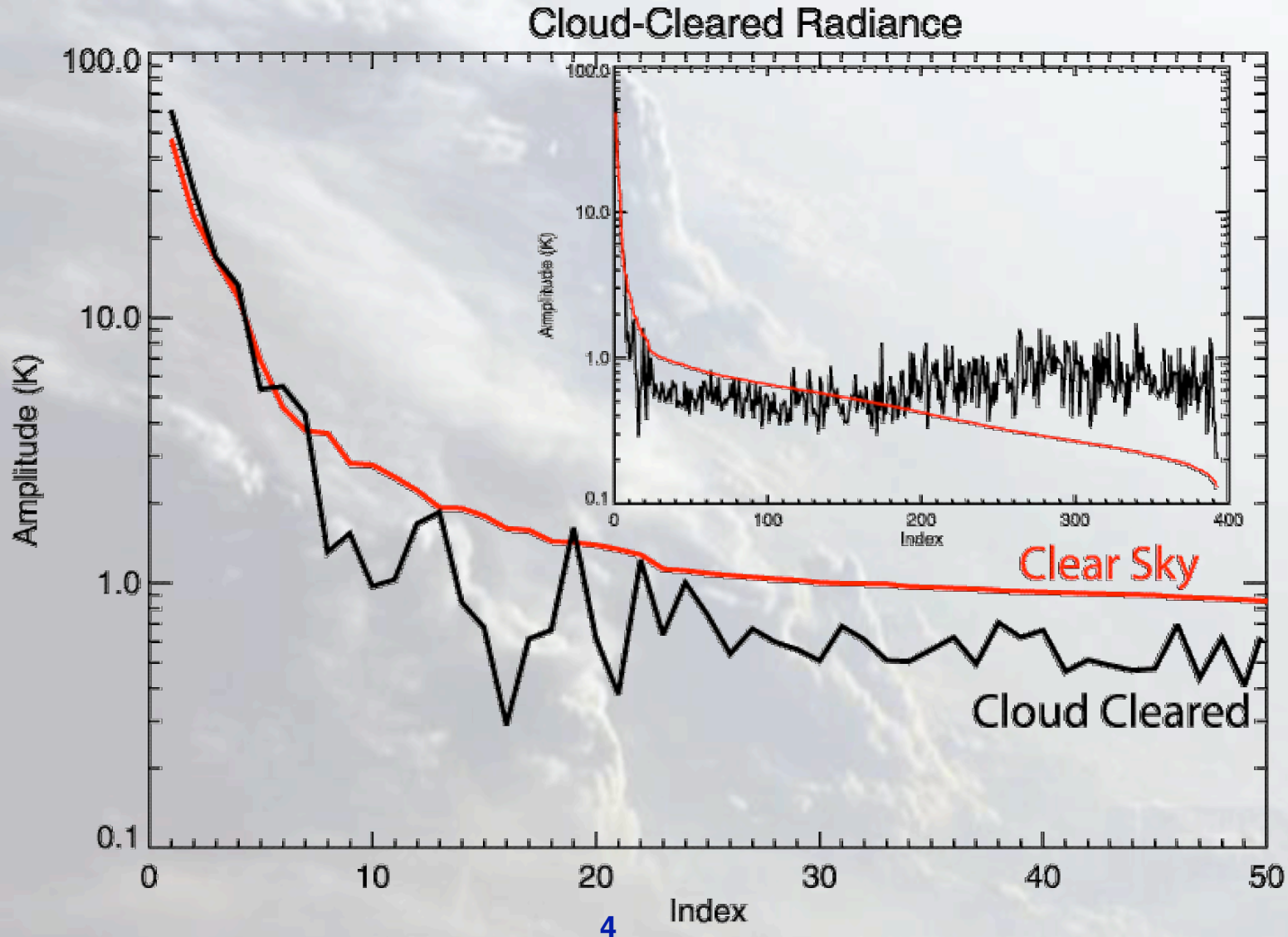
Version 3.5
Clear versus Cloud-Cleared Covariance



Version 3.5 Conclusions

- **Application of cloud-contamination test**
  - ***Most of CC radiances past test***
- **Assessment of quality based on impact on retrieved products**
  - ***Outlier rate not dependent on clear test***
    - Suggests outliers do not arise from errors in CC radiances
- **Statistical Characteristics**
  - ***Small differences in most significant eigenvectors***
    - Larger more varied ensemble of states
    - Cloud clearing has only 6 degrees of freedom per AMSU footprint
      - Correlated errors in cloud formations could amplify variance
      - AMSU systematic errors could produce correlated errors in cloud formations
  - ***Larger eigenvalues at least significant eigenvalues***
    - Evidence for noise amplification

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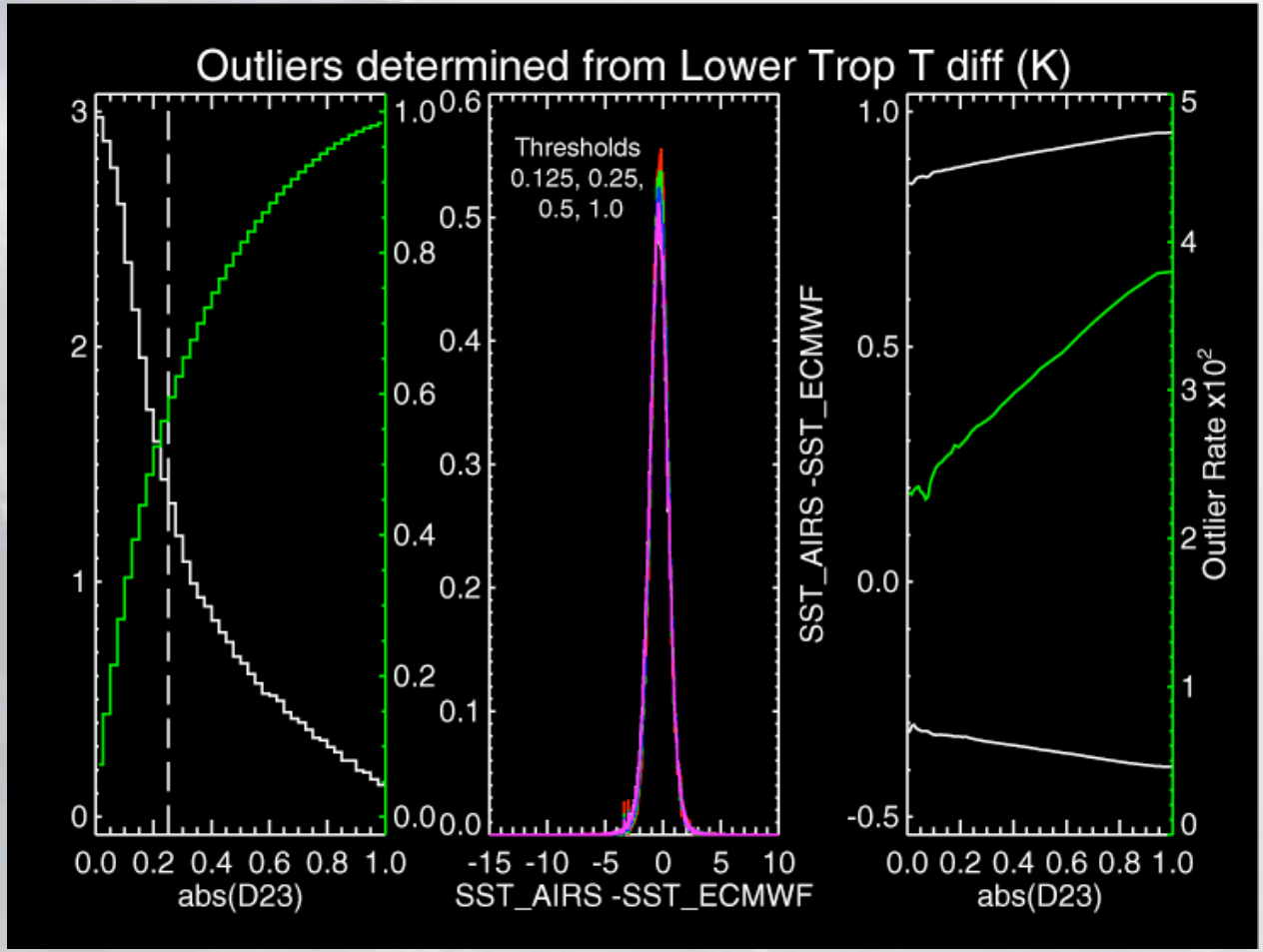
Version 4.0 SST Inter-comparisons Outlier Rate

- Possibly more skill
- Outlier rate decreasing with tightening



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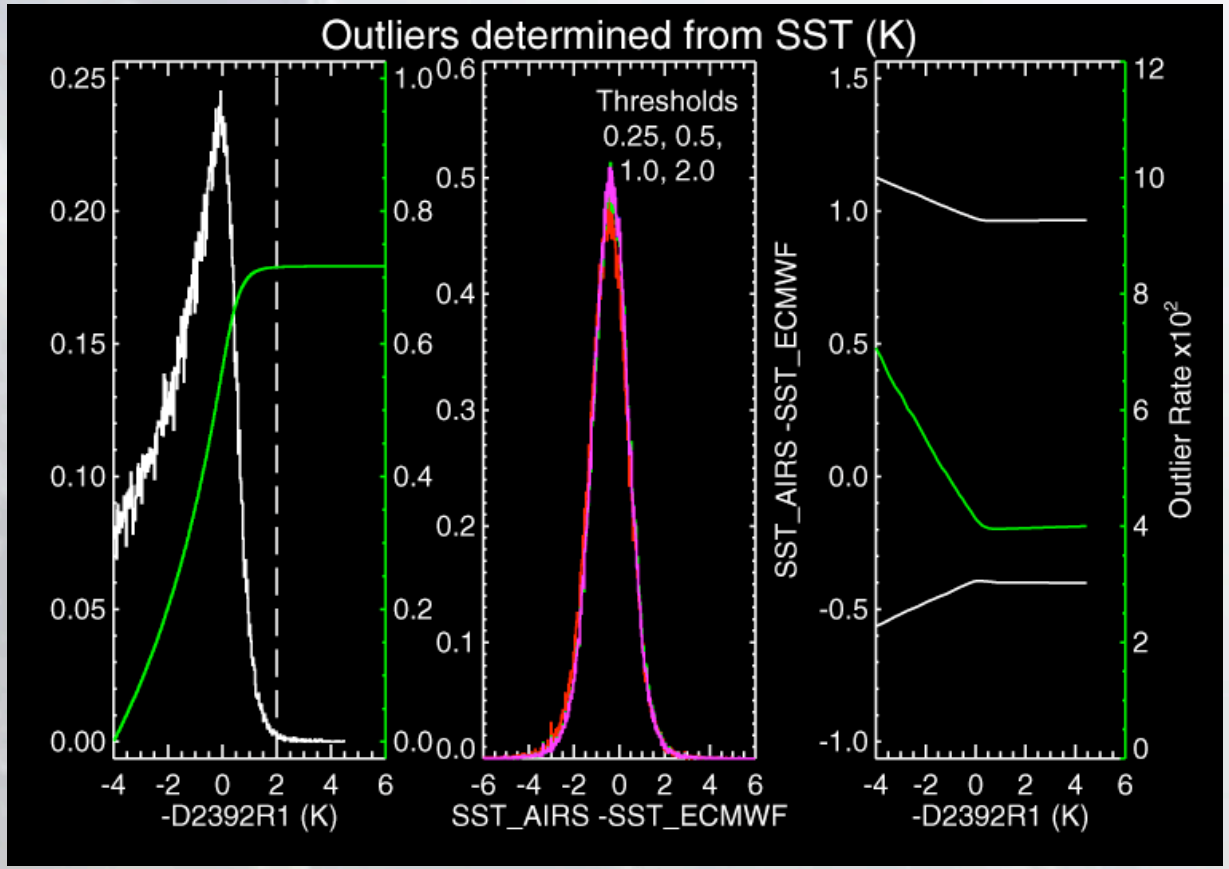
Version 4.0 SST Inter-comparisons Outlier Rate

LW / SW SST Difference

- Same as Version 3.4
- Discriminant smaller than clear threshold
- Density of SST differences independent of discr.
- Precision (bias) and accuracy of SST are independent of discr.
  - *Decreases with discr*
  - *Outlier rate increases*
- Cloud-clearing is working to reliability of discriminant



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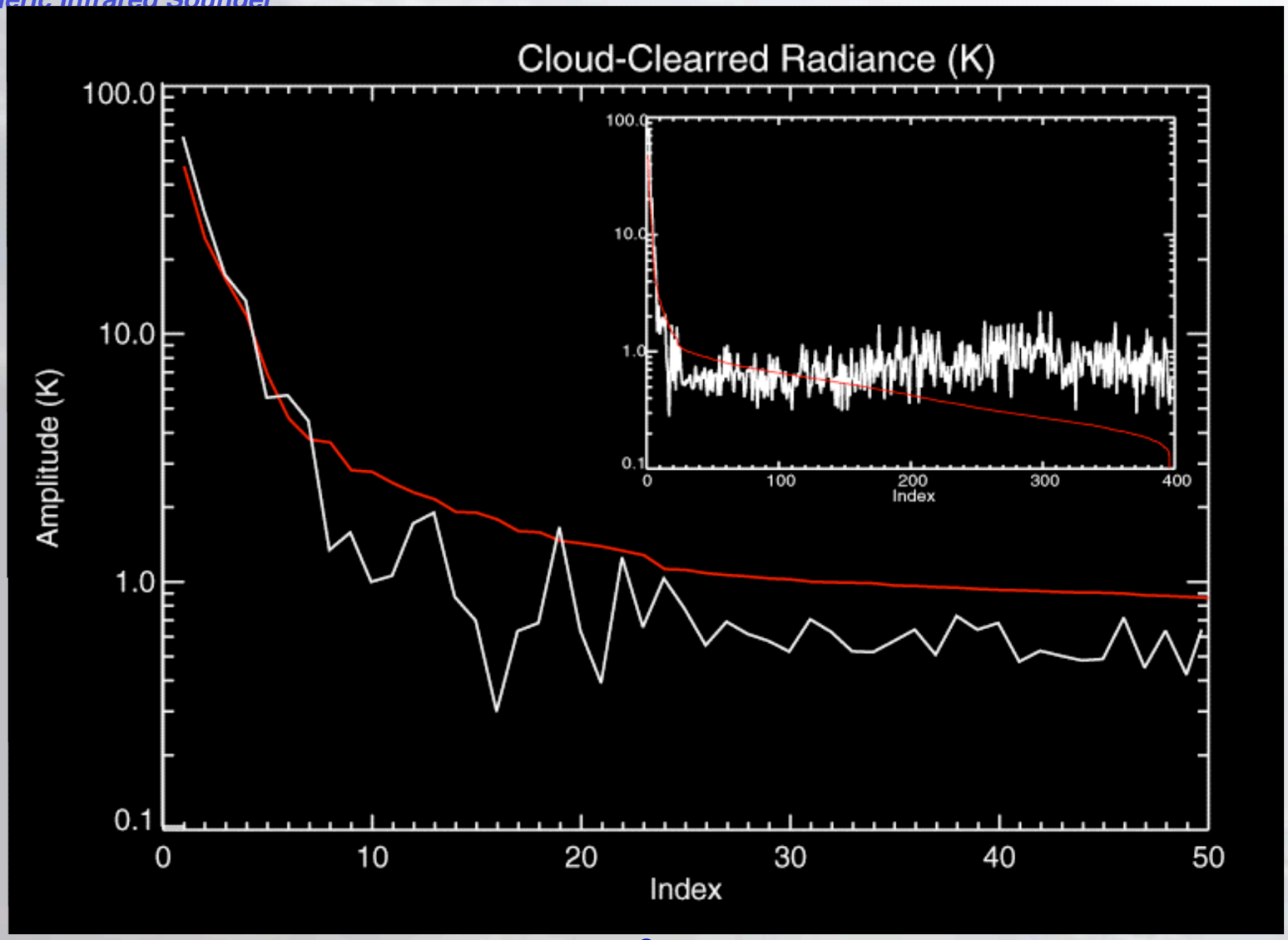
Version 4.0
Clear versus Cloud-Cleared Eigenvalues



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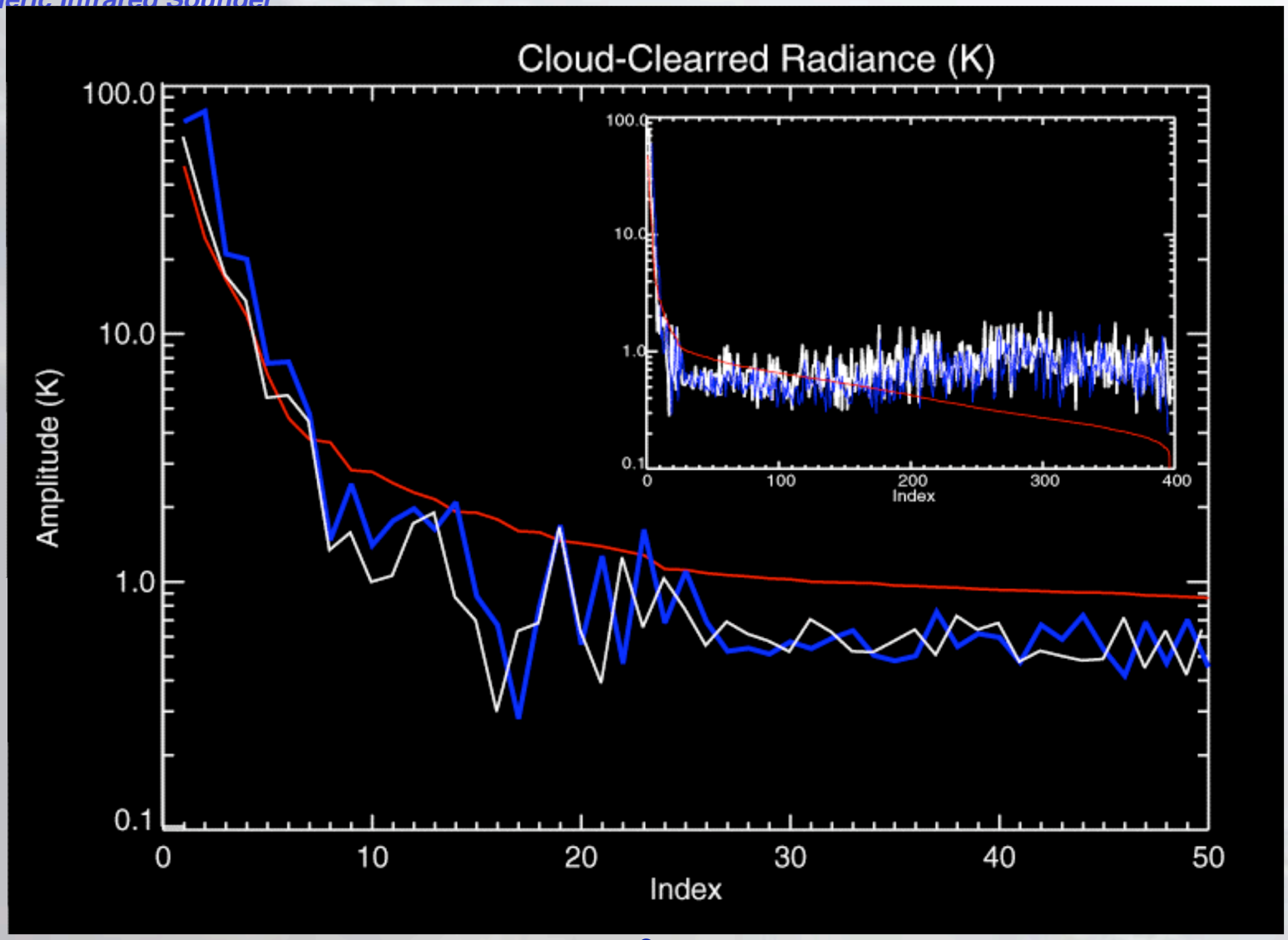
Version 4.0
Clear versus Cloud-Cleared Covariance



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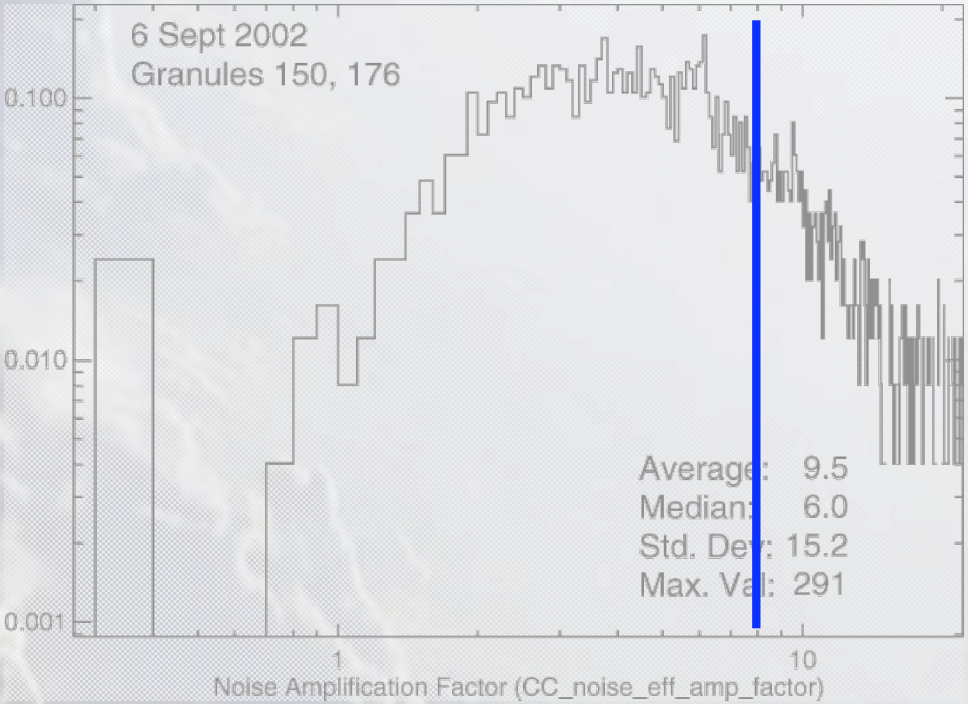
Noise Amplification

- **Increase in radiance noise by cloud clearing**
- **Applicable to surface sensing channels**
- **9 clear footprints has NaF of 1/3**

- **Concern about amplification of systematic errors**



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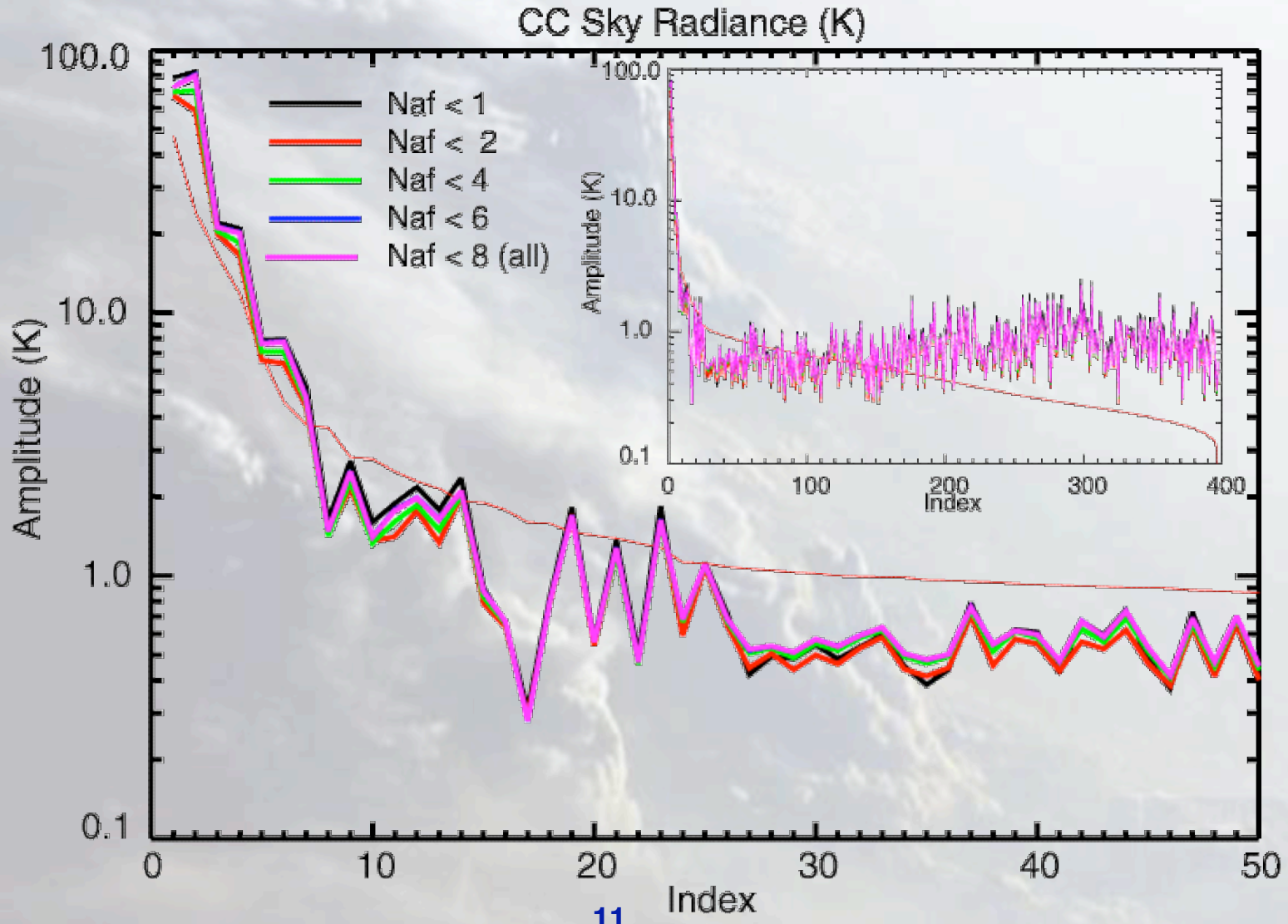
Covariance Dependence on Noise Amplification



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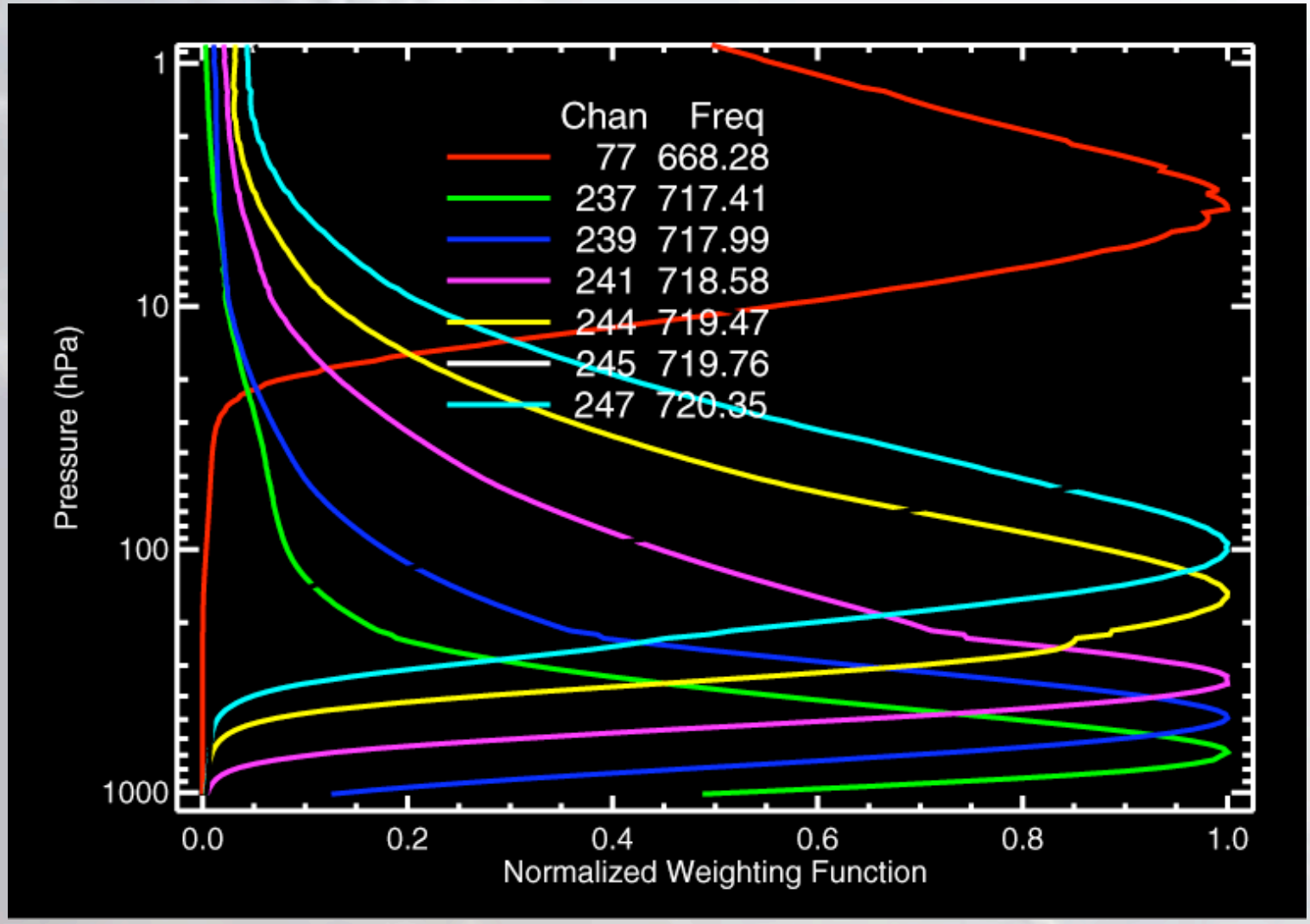
Weighting Function Through Cloud Layers



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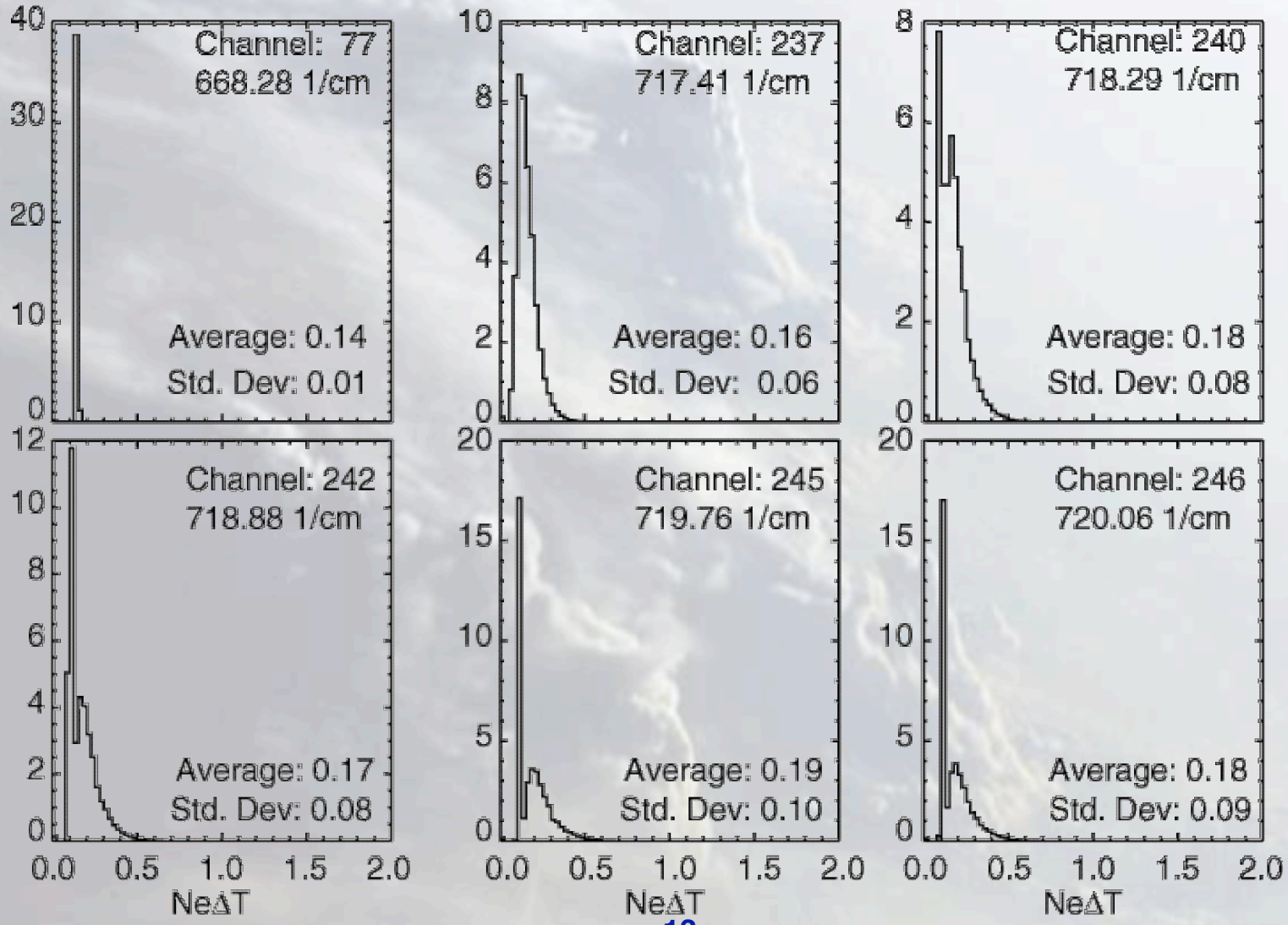
Height –Dependence of Noise Amplification



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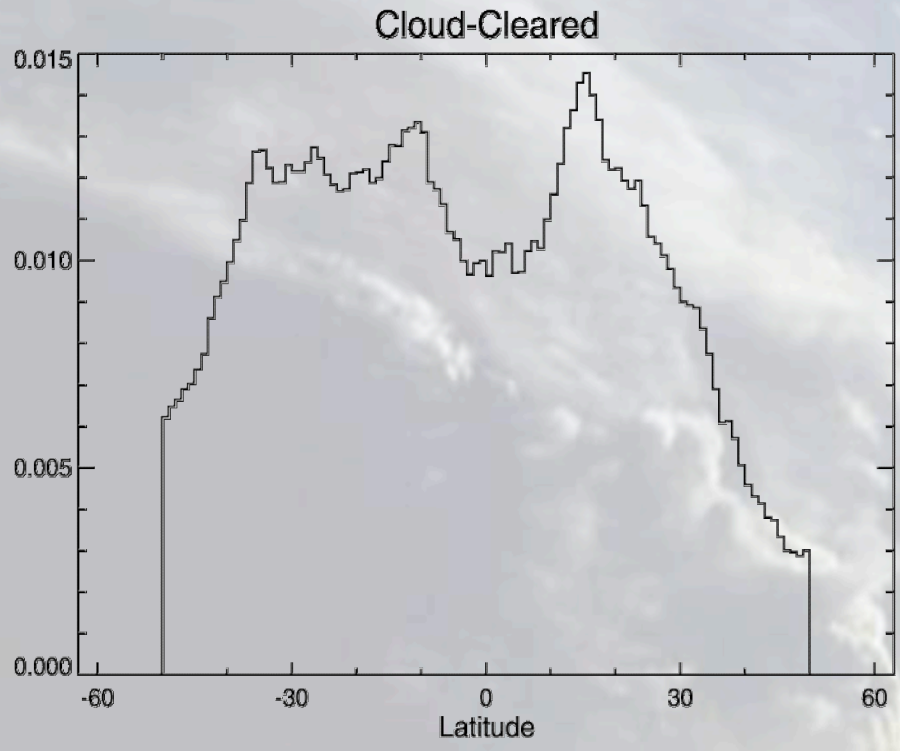
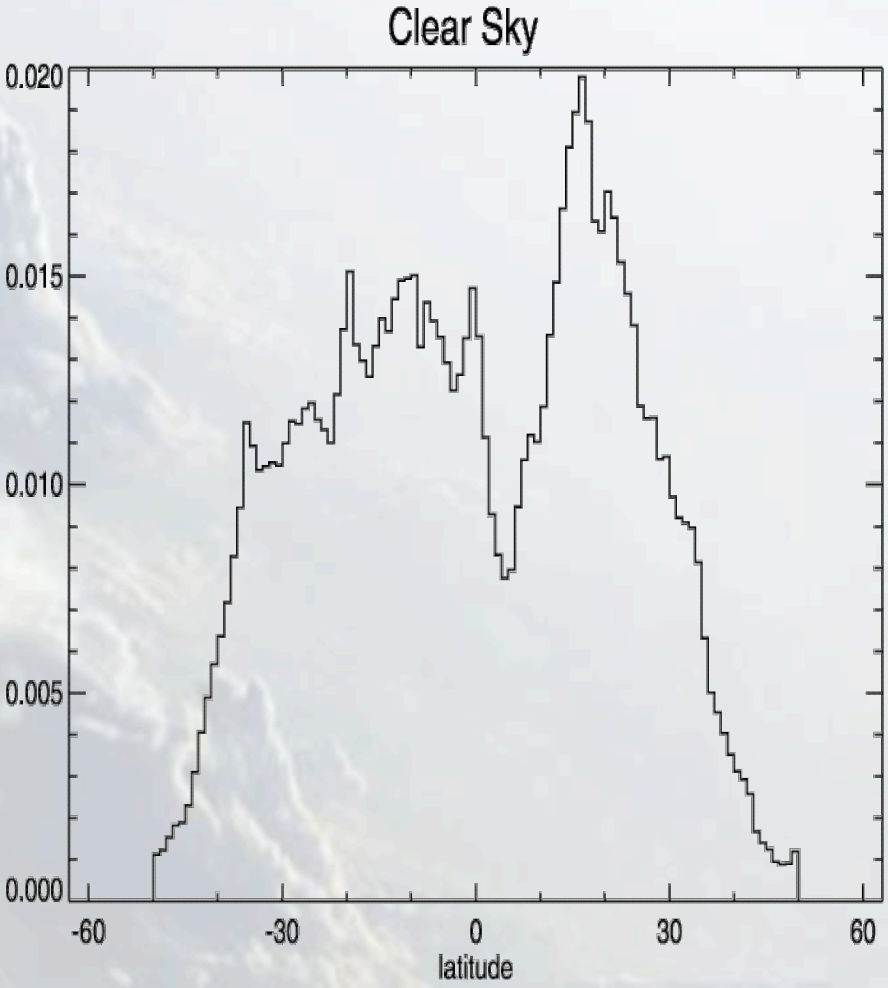
Latitude Sampling





Conclusions

- **Application of cloud-contamination test**
  - ***Most of CC radiances past test***
- **Assessment of quality based on impact on retrieved products**
  - ***Outlier rate not dependent on clear test***
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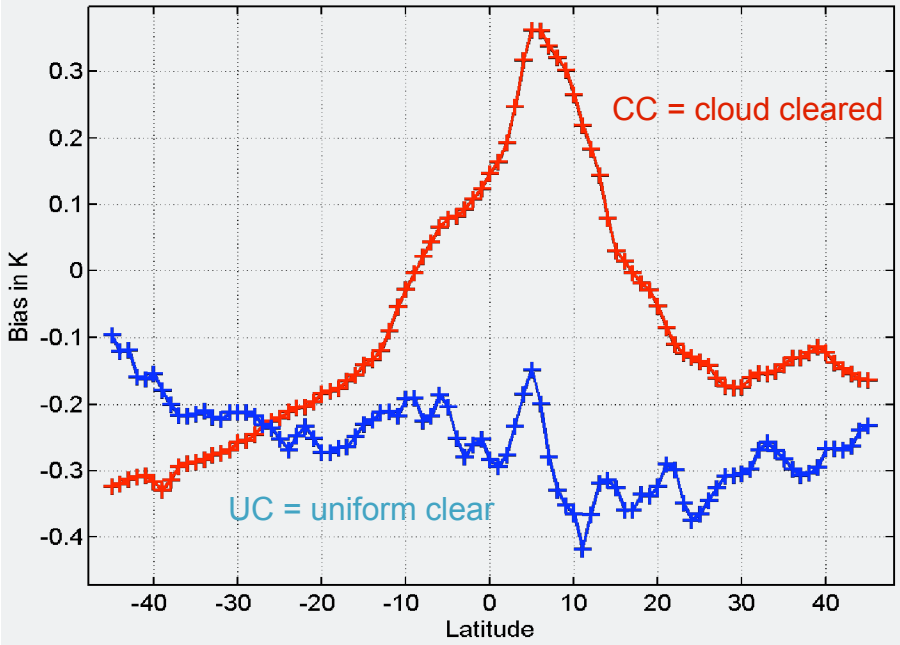
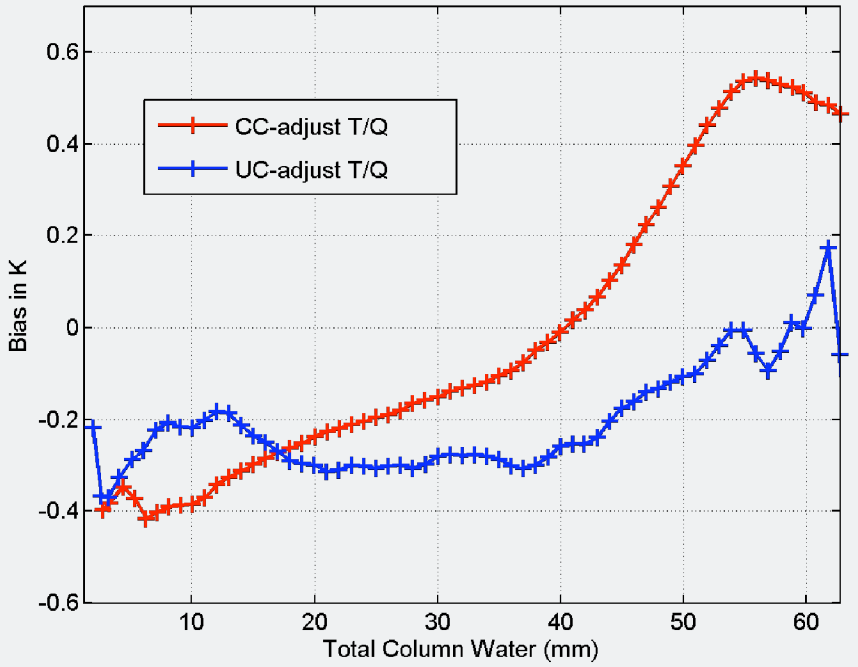
    - Evidence of noise amplification

805 cm^{-1} Bias

(Window Channel with Strong Water Continuum)





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Clear Scene Prescription

Name	Description	Location	Time of Day	Default Condition
SST1231r5	SST from LW channels using a split window	Ocean	Day/Night	
SST2392r1	SST from SW channels using lapse rate extrapolation	Ocen	Day/Night	
d2392r1	Difference of SST from LW and SW channels, SST1231r5-SST2392r1	Ocean	Day/Night	> -2K
dd12g5	SST LW/SW difference with glint correction	Ocean	Day	abs < 0.5K
d12	SST LW/SW difference w/o glint correction	Ocean	Night	abs < 0.25K
d23	LW Thin cirrus and silicate dust predictor	Ocean	Day/Night	abs < 0.25K
d34	LW Thin cirrus predictor	Ocean	Day/Night	abs < 0.5K
lrt	SW lapse rate	Tropical Ocean	Day/Night	> 3.5K
g5n	SW sun glint detector	Ocean	Day	< 3
spatial_coh 11 um	Std Deviation in LW predicted SST	Everywhere	Day/Night	< 0.5

Supplemental Slides

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Empirical Orthogonal Functions Data

- **Train on 826,340 identified clear spectra (11 Focus Days)**
- **LW temperature sounding channels (470)**